Facilities Management
THE UNIVERSITY OF IOWA

Utilities and Energy Management

September 6, 2013

Lisa Hanlon
U.S. EPA Region 7
Air Permitting and Compliance
11201 Renner Blvd.
Lenexa, KS 66219

Subject: University of Iowa Boiler MACT Compliance Testing for Hurst Boiler (Permit # 78-A-023-S7)

Dear Ms. Hanlon:

Enclosed with this letter please find results of emissions testing, performed by Mostardi Platt at the University of Iowa Oakdale Campus on July 23, and 24 of 2013. The purpose of the testing was to demonstrate initial compliance with NESHAP Subpart DDDDD requirements for this unit, which is classified as a new, "stoker/sloped grate/others designed to burn wet biomass fuel."

The required testing included filterable particulate matter, carbon monoxide, mercury, and hydrogen chloride (HCl). Additional testing for nitrogen oxides, and total particulate matter was also performed. The fuel used during the testing was wood chips. As can be seen in the test results summary table on page 1 of the report, the boiler tested below the NESHAP limits for HCl, mercury, and carbon monoxide, but exceeded the particulate matter limit of 0.03 lb/mmbtu. Additionally, the boiler was not able to achieve its rated steam generating capacity of 20,000 lbs/hour during the testing. Operational data, reported on pages 11 through 19, show that the boiler operated at a steaming rate of between 10,000 and 13,000 lbs/hour during the testing. Due to this testing failure the boiler will not be operated on solid fuel until compliance can be demonstrated with further testing. However, the boiler will continue to be operated on natural gas, as approved by Scott Postma in a September 3, 2013 email.

We feel this testing failure was a result of problems with the particulate matter control device installed following the Hurst Boiler. We will be working with the supplier of that equipment over the next few months to identify the problems and develop solutions. Once we have determined the extent of the problems we will submit a compliance plan and schedule, for bringing the unit into compliance with permit conditions, so it can be operated on solid fuel again.

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Please contact me at 319-335-6185 with any questions or concerns.

Sincerely,

Mark Maxwell

Mark W. Maxwell
Environmental Engineer

enclosure

cc: Scott Postma, QSTO 1, 2, 3
Region VII, EPA
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Kansas City, KS 66101

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mostardi platt

MACT Emissions Test Report

University of Iowa
Oakdale Renewable Energy Plant
Hurst Boiler Exhaust Duct
Coralville, Iowa
July 23 and 24, 2013

Report Submittal Date
August 27, 2013

Project No. M133003

888 Industrial Drive
Elmhurst, Illinois 60126
630-993-2100

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1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a MACT emissions test program for University of Iowa at the Oakdale Renewable Energy Plant in Coralville, Iowa on the Hurst Boiler Exhaust Duct on July 23 and 24, 2013. This report summarizes the results of the test program and test methods used.

The test location, test dates, and test parameters are summarized below.

TEST INFORMATION		
Test Location	**Test Dates**	**Test Parameters**
Hurst Boiler Exhaust Duct	July 23 and 24, 2013	Filterable Particulate Matter (FPM), Total Particulate Matter (TPM), Nitrogen Oxides (NO_x), Carbon Monoxide (CO), Mercury (Hg), and Hydrogen Chloride (HCl)

Selected results of the test program are summarized below. A complete summary of emission test results follows the narrative portion of this report.

TEST RESULTS					
Test Location	**Date**	**Test Parameter**	**MACT Emission Limits**	**Permitted Emission Limits**	**Emission Rates**
Hurst Boiler Exhaust Duct	7/23 & 24/13	FPM	0.03 lb/mmBtu		0.0683 lb/mmBtu
		TPM		1.073 lb/hr	1.660 lb/hr
				0.1 gr/dscf	0.0300 gr/dscf
	7/23/13	HCl	0.022 lb/mmBtu		0.0004 lb/mmBtu
	7/24/13	Hg	0.8 lb/TBtu		0.1905 lb/TBtu
		NOx		4.13 lb/hr	1.60 lb/hr
		CO	620 ppm @ 3% O_2		4.5 ppm @ 3% O_2
				4.13 lb/hr	0.07 lb/hr

Calculated Fd-Factors obtained from fuel analysis provided by the University of Iowa were used to calculate emissions on lb/mmBtu and lb/TBtu basis. Spike concentrations for the Hg sampling were selected based on the expected values. The spikes were in the expected range with the exception of Run 3.

The Stationary Source Audit Sample Program audit sample was obtained and submitted for analysis to Maxxam Analytics. The results of that audit sample were compared to the assigned value by ERA and found to be acceptable. The audit sample results and evaluation are appended to this report.

Operating data as provided by the University of Iowa are included in Appendix A.

The identification of individuals associated with the test program is summarized below.

TEST PERSONNEL INFORMATION		
Location	**Address**	**Contact**
Test Coordinator	The University of Iowa Oakdale Renewable Energy Plant Oakdale Campus Coralvillle, Iowa 52319	Mr. Mark Maxwell Environmental Engineer (319) 335-6185 (phone) mark-maxwell@uiowa.edu
Testing Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Mr. James F. Robertson Project Manager (630) 993-2100 (phone) jrobertson@mp-mail.com

The test crew consisted of Messrs. A. Dickinson, D. Tuider, and J. Robertson of Mostardi Platt.

2.0 TEST METHODOLOGY

Emission testing was conducted following the methods specified in 40CFR60, Appendix A and 40CFR51, Appendix M. Schematics of the test section diagrams and sampling trains used are included in Appendix B and C, respectively. Calculation nomenclature and example calculations are included in Appendix D. Appendix E includes laboratory sample analysis. Copies of reference method data sheets and field data sheets for each test run are included in Appendix F and G.

The following methodology was used during the test program:

Method 1 Traverse Point Determination

Test measurement points were selected in accordance with Method 1. The characteristics of measurement location are summarized below.

TEST POINT INFORMATION				
Location	**Upstream Diameters**	**Downstream Diameters**	**Test Parameter**	**Number of Sampling Points**
Hurst Boiler Exhaust Duct	>0.5	>2.0	TPM	30
			Volumetric Flow, NO_x and CO	20
			Hg	3
			HCl	1

Stratification Test for Gaseous Sampling

A 20 point gaseous stratification test was performed during Run 1. All of the results were greater than 10 % difference and consequently 20 points were used for Runs 2 and 3.

Method 2 Volumetric Flow Rate Determination

Gas velocity was measured following Method 2, for purposes of calculating exhaust gas volumetric flow rate and emission rates on a lb/hr basis. An S-type pitot tube, differential

pressure gauge, thermocouple and temperature readout were used to determine gas velocity at each sample point. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Method 3A Oxygen (O_2)/Carbon Dioxide (CO_2) Determination

CO_2 and O_2 concentrations were measured to determine exhaust gas molecular weight in accordance with Method 3A. A Servomex analyzer was used to determine stack gas O_2 and CO_2 content and, by difference, nitrogen content. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H and copies of gas cylinder certifications are included in Appendix I.

Method 4 Moisture Determination

USEPA Method 4 was utilized to determine water (H_2O) content of the exhaust gas. 100 milliliters (ml) of water were added to each of the first two impingers, the third impinger was left empty, and the fourth impinger was charged with approximately 200 grams of silica gel. The impingers were placed in an ice bath to maintain the sampled gas passed through the silica gel impinger outlet below 68°F in order to increase the accuracy of the sampled dry gas volume measurement. The water volumes of the impinger train were measured and the silica gel was weighed before and after each test run to determine the mass of moisture condensed.

Each sample was extracted through a heated stainless-steel probe and filter assembly at a constant sample rate of approximately 0.75 cubic feet per minute, which was maintained throughout the course of the test run. A minimum of 21 dry standard cubic feet (dscf) are sampled for, each moisture run. After each run, a leak check of the sampling train was performed at a vacuum greater than the sampling vacuum to determine if any leakage had occurred during sampling. Following the leak check, the impingers were removed from the ice bath, water levels were measured, and the silica gel weight was recorded.

All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Method 7E Nitrogen Oxide (NO_X) Determination

Exhaust gas nitrogen oxide concentrations and emission rates were determined in accordance with Method 7E. A Thermo Scientific 42 Series nitrogen oxide analyzer was used to determine nitrogen oxide concentrations, in the manner specified in the Method.

Exhaust gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 250°F. Excess moisture in the exhaust gas was removed using a refrigerated condenser. The entire system was calibrated in accordance with the Method, using certified calibration gases introduced at the probe, before and after each test run.

A list of calibration gases used and the results of all calibration and other required quality assurance checks can be found in Appendix H. Copies of gas cylinder certifications are included in Appendix I.

Method 10 Carbon Monoxide (CO) Determination

Exhaust gas carbon monoxide concentrations and emission rates were determined in accordance with Method 10. A Thermo Scientific 48 Series carbon monoxide analyzer was used to determine carbon monoxide concentrations, in the manner specified in the Method.

Exhaust gas was delivered to the analyzer via a Teflon® sampling line, heated to a minimum temperature of 250°F. Excess moisture in the exhaust gas was removed using a refrigerated condenser The entire system was calibrated in accordance with the Method, using certified calibration gases introduced at the probe, before and after each test run.

A list of calibration gases used and the results of all calibration and other required quality assurance checks can be found in Appendix H. Copies of gas cylinder certifications are included in Appendix I.

Method 5 Filterable Particulate Matter (FPM) Determination

Exhaust gas FPM concentrations and emission rates were determined in accordance with Method 5. An Environmental Supply Company sampling train was used to sample stack gas at an isokinetic rate, as specified in the Method. Particulate matter in the sample probe was recovered using an acetone wash. The probe wash and filter catch were analyzed by Mostardi Platt in accordance with the Method. Laboratory analysis data are included in Appendix D. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Method 202 Condensable Particulate Matter (CPM) Determination

Exhaust gas CPM particulate concentrations and emission rates were determined in accordance with the Method 202, in conjunction with Method 5 filterable particulate matter sampling. Condensable particulate matter CPM was collected in the impinger portion of the Method 5/202 sampling train.

CPM was collected in the condenser, knockout impinger, modified Greenburg Smith impinger and ambient filter portion of the sampling train as described in this Method. The impinger contents were purged with nitrogen (N_2) immediately after sample collection to remove dissolved sulfur dioxide (SO_2) gases from the impingers. The impinger solution was then extracted with DI water, acetone, and hexane. The CPM filter was placed in a sonication bath and extracted with DI water and hexane. The organic and aqueous fractions were then dried and the residues weighed. The total of the aqueous, organic, and ambient filter fractions represents the CPM.

Laboratory analysis data are included in Appendix E. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Method 26 Hydrogen Chloride (HCl) Determination

Exhaust gas Hydrogen Chloride (HCl) concentration and emission rates were determined in accordance with Method 26. An Environmental Supply Company, Inc. sampling train was used to collect the sample. A single-point sample was extracted from the gas stream and passed through dilute (0.1 N) sulfuric acid. In the dilute acid, the HCl dissolved and formed chloride (Cl) ions. The sample train consisted of a Teflon® filter placed on the outlet of a heated borosilicate

glass probe liner and five impingers. The first two impingers contained the dilute sulfuric acid, the third and fourth impingers contained a 0.1 N sodium hydroxide (NaOH), and the fifth impinger contained silica gel to absorb any remaining moisture. A DI rinse was performed on each set of impingers, and samples were stored in nalgene sample containers for transport. The dilute sulfuric acid samples were then analyzed for HCl by Maxxam Analytics, Inc. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Mercury Determination by Method 30B (Sorbent Trap Method)

Paired trains were utilized using three test points.

Per Method 30B sampling, each sample was collected on the paired in-situ sorbent traps. A tube of silica was used to capture remaining moisture prior to the sample reaching the gas metering system.

The sample train used for this test program was designed by APEX, Inc. and meets all requirements for Method 30B sampling. Samples were analyzed onsite utilizing an Ohio Lumex, Inc. analyzer for total gaseous mercury. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H. Mercury quality assurance and control data are found in Appendix J.

3.0 TEST RESULT SUMMARIES

University of Iowa Oakdale Renewable Energy Plant Hurst Boiler Exhaust Duct Gaseous Summary									
Test No.	Date	Start Time	End Time	NO_x, ppm (dry)	CO, ppm (dry)	CO_2, % (dry)	O_2, % (dry)	CO, ppm @ 3%O_2	Flowrate, DSCFM
1	07/24/13	10:15	11:38	36.3	2.1	9.4	11.4	4.0	6,282.0
2	07/24/13	12:29	13:49	34.4	2.1	9.6	11.1	3.8	6,466.0
3	07/24/13	14:45	16:00	33.2	3.2	9.6	11.1	5.8	6,580.0
Average				34.6	2.5	9.5	11.2	4.5	6,442.7

Emission Rate Summary

Test No.	Date	Start Time	End Time	Fd Factor, dscf/MMBtu	O2 based NOx lb/MMBtu	NO_x lb/hr	O2 based CO lb/MMBtu	CO lb/hr
1	07/24/13	10:15	11:38	9,310.3	0.089	1.63	0.003	0.06
2	07/24/13	12:29	13:49	9,372.8	0.082	1.59	0.003	0.06
3	07/24/13	14:45	16:00	9,324.4	0.079	1.57	0.005	0.09
Average				9,335.8	0.083	1.60	0.004	0.07

Client: University of Iowa
Facility: Oakdale Renewable Energy Plant
Test Location: Hurst Boiler Exhaust Duct
Test Method: 5/202

Source Condition	Normal	Normal	Normal	
Date	7/23/13	7/23/13	7/23 & 24/13	
Start Time	12:05	16:30	21:18	
End Time	15:01	19:54	0:05	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	359.3	359.0	366.4	361.6
Flue Gas Moisture, percent by volume	16.1%	15.0%	18.1%	16.4%
Average Flue Pressure, in. Hg	29.29	29.29	29.29	29.29
Gas Sample Volume, dscf	70.880	65.914	74.673	70.489
Average Gas Velocity, ft/sec	10.602	9.945	11.439	10.662
Gas Volumetric Flow Rate, acfm	12,245	11,486	13,212	12,314
Gas Volumetric Flow Rate, dscfm	6,483	6,165	6,765	6,471
Gas Volumetric Flow Rate, scfm	7,726	7,249	8,264	7,746
Average $\%CO_2$ by volume, dry basis	10.9	10.2	10.4	10.5
Average $\%O_2$ by volume, dry basis	9.8	10.5	10.3	10.2
Isokinetic Variance	105.0	102.7	106.1	104.6
Fd Factor, dscf/mmBtu	9,492.0	9,334.4	9,407.7	9,411.4
Filterable Particulate Matter (Method 5)				
grams collected	0.1279	0.1080	0.1204	0.1188
grains/acf	0.0147	0.0136	0.0127	0.0137
grains/dscf	0.0278	0.0253	0.0249	0.0260
lb/hr	1.547	1.336	1.443	1.442
lb/mmBtu (Calculated Fd Factor)	0.0711	0.0678	0.0659	0.0683
Condensable Particulate Matter (Method 202)				
grams collected	0.0200	0.0139	0.0201	0.0180
grains/acf	0.0023	0.0017	0.0021	0.0020
grains/dscf	0.0044	0.0033	0.0042	0.0040
lb/hr	0.242	0.172	0.241	0.218
lb/mmBtu (Calculated Fd Factor)	0.0111	0.0087	0.0110	0.0103
Total Particulate Matter (5/202)				
grams collected	0.1479	0.1219	0.1405	0.1368
grains/acf	0.0170	0.0153	0.0148	0.0157
grains/dscf	0.0322	0.0286	0.0291	0.0300
lb/hr	1.789	1.508	1.684	1.660
lb/mmBtu (Calculated Fd Factor)	0.0822	0.0765	0.0769	0.0785

HCl Test Results Summary
University of Iowa
Oakdale Renewable Energy Plant
Hurst Boiler Exhaust Duct

Run No.	Location	Date	Time	Meter Volume, dscf	O_2, % dry	HCl detected, mg	HCl Concentration ppmvd	Fd Factor	HCl lbs/MMBtu
1	Stack	7/23/2013	12:05-13:05	4.05	9.80	0.043	0.25	9492.0	0.0004
2	Stack	7/23/2013	13:35-14:35	4.04	9.80	0.030	0.17	9492.0	0.0003
3	Stack	7/23/2013	14:45-15:55	4.03	9.80	0.055	0.32	9492.0	0.0005
Average							0.25	9492.0	0.0004

Method 30B (Sorbent Trap) Mercury Test Results Summary
University of Iowa
Oakdale Renewable Energy Plant
Hurst Boiler Exhaust Duct

Test No.	Date	Start Time	End Time	V_m (standard L)	ng detected	ppb	ug/dscm	ug/wscm	lb/Tbtu (Fd Factor)
1A	7/24/2013	10:18	11:18	104.512	22.60	0.03	0.22	0.18	0.2765
1B				93.516	20.70	0.03	0.22	0.18	0.2838
Average					**21.65**	**0.03**	**0.22**	**0.18**	**0.2802**
2A	7/24/2013	12:30	13:30	94.844	12.40	0.02	0.13	0.11	0.1631
2B				93.761	12.60	0.02	0.13	0.11	0.1670
Average					**12.50**	**0.02**	**0.13**	**0.11**	**0.1651**
3A	7/24/2013	14:45	15:45	94.449	10.60	0.01	0.11	0.09	0.1393
3B				93.474	8.50	0.01	0.09	0.07	0.1130
Average					**9.55**	**0.01**	**0.10**	**0.08**	**0.1262**
Overall Average					**14.57**	**0.02**	**0.15**	**0.12**	**0.1905**

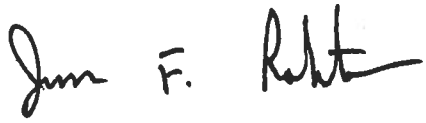
4.0 CERTIFICATION

MOSTARDI PLATT is pleased to have been of service to University of Iowa. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

CERTIFICATION

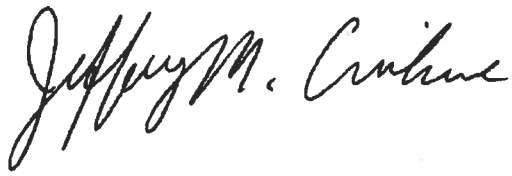
As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

MOSTARDI PLATT



Project Manager

James F. Robertson



Quality Assurance

Jeffrey M. Crivlare

APPENDICES